USB 3.1 ENGINEERING CHANGE NOTICE

Title: Rx AC Coupling Capacitor Option
Applied to: USB Specification Version 3.1

Brief description of the functional changes proposed:
This ECN adds an AC coupling capacitor in RX side both host and device if need be. This is optional for some vendors.

Benefits as a result of the proposed changes:
This capacitor is useful for ESD/EOS protection and remove unwanted bias level from Rx side. Because RX side of different UBS-SS system have variable common mode voltage (use different termination scheme), this option can remove unmatched bias level for interconnection logic. After adding this capacitor leakage current through RX pin can be ideally 0mA and it is helpful to prevent water corrosion. (Same as TX side)

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
Total series capacitance can be slightly reduced. However combined value of 100nF (TX side) and 330nF (Optional RX side) can be meet minimum capacitance requirement for RX detection (75nF~265nF) and there is no expected effect.

An analysis of the hardware implications:
None

An analysis of the software implications:
None

An analysis of the compliance testing implications:
None

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Actual Change Requested

From Text:
Section 6.2, Figure 6-5 Channel Models, Page 161
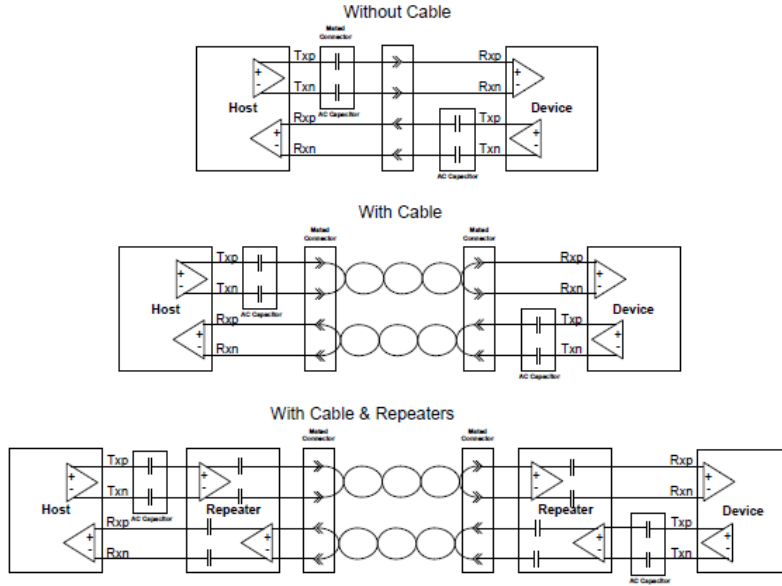

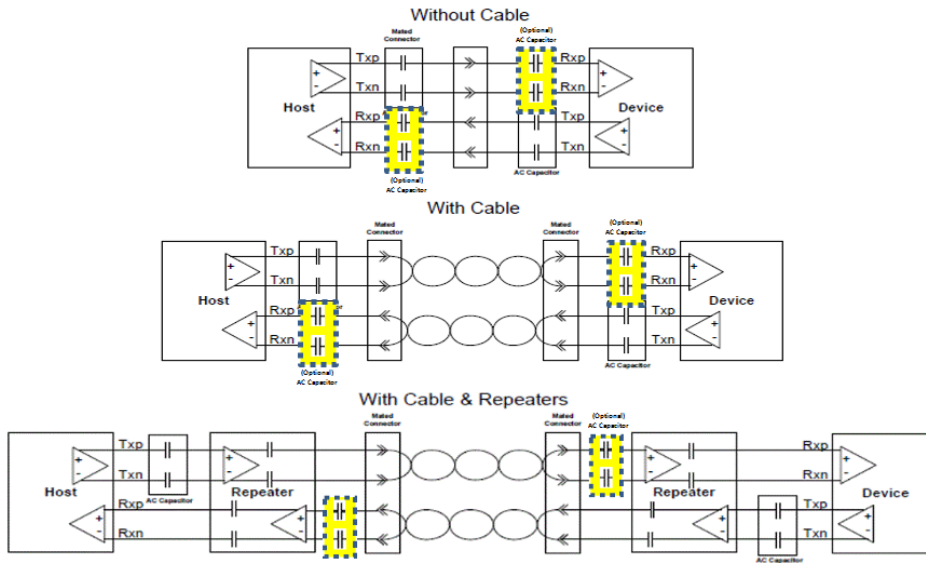**Figure 6-5. Channel Models**

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Figure 6-5. Channel Models

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From Text:
Section 6.8.3, Table 6-21, pp 6-39

Table 6-1. Receiver Normative Electrical Parameters

Symbol	Parameter	Gen 1 (5.0 GT/s)	Gen 2 (10 GT/s)	Units	Comments
UI	Unit Interval	199.94 (min) 200.06 (max) 200.34 (min) 200.46 (max)	99.97 (min)100.03 (max) 100.17 (min) 100.23 (max)	ps ps	UI does not account for SSC caused variations. Alternate limits apply to "radio friendly" clocking mode which employs a clock whose center frequency is downshifted by 2000ppm. This mode is to be used with a +0/-3000ppm spread.
R_{RX-DC}	Receiver DC common mode impedance	18 (min) 30 (max)	18 (min) 30 (max)	Ω	DC impedance limits are needed to guarantee Receiver detect. Measured with respect to ground over a voltage of 500 mV maximum.
$R_{RX-DIFF-DC}$	DC differential impedance	72 (min) 120 (max)	72 (min) 120 (max)	Ω	
$Z_{RX-HIGH-IMP-DC-POS}$[1]	DC Input CM Input Impedance for V>0 during Reset or power down	10k (min)	10k (min)	Ω	Rx low frequency CM impedance with the Rx terminations not powered, Defined at the transmitter side of the AC cap as min(delta_V/delta_I) upon application of a positive Tx step of any size up to +500mV from steady state.
$V_{RX-LFPS-DET-DIFFp-p}$	LFPS Detect Threshold	100 (min) 300 (max)	100 (min) 300 (max)	mV	Below the minimum is noise. Must wake up above the maximum.

Note
1. Impedance is only specified for $\Delta V>0$. $\Delta V<0$ is not specified and could be as low at 0Ω.
2. Steady-state is defined as no change voltage on Tx or Rx nodes and zero current flow through the AC cap.

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Table 6-2. Receiver Normative Electrical Parameters

Symbol	Parameter	Gen 1 (5.0 GT/s)	Gen 2 (10 GT/s)	Units	Comments
UI	Unit Interval	199.94 (min) 200.06 (max)	99.97 (min)100.03 (max)	ps	UI does not account for SSC caused variations.
		200.34 (min) 200.46 (max)	100.17 (min) 100.23 (max)	ps	Alternate limits apply to "radio friendly" clocking mode which employs a clock whose center frequency is downshifted by 2000ppm. This mode is to be used with a +0/-3000ppm spread.
R_{RX-DC}	Receiver DC common mode impedance	18 (min) 30 (max)	18 (min) 30 (max)	Ω	DC impedance limits are needed to guarantee Receiver detect. Measured with respect to ground over a voltage of 500 mV maximum.
$R_{RX-DIFF-DC}$	DC differential impedance	72 (min) 120 (max)	72 (min) 120 (max)	Ω	
$Z_{RX-HIGH-IMP-DC-POS}$[1]	DC Input CM Input Impedance for V>0 during Reset or power down	10k (min)	10k (min)	Ω	Rx low frequency CM impedance with the Rx terminations not powered, Defined at the transmitter side of the AC cap as min(delta_V/delta_I) upon application of a positive Tx step of any size up to +500mV from steady state.
$V_{RX-LFPS-DET-DIFFp-p}$	LFPS Detect Threshold	100 (min) 300 (max)	100 (min) 300 (max)	mV	Below the minimum is noise. Must wake up above the maximum.
$C_{RX-AC-COUPLING}$	AC Coupling Capacitor	297 (min) 363 (max)	297 (min) 363 (max)	nF	Receivers may be AC coupled if desired. If used, the AC coupling is required to be either within the media or within the receiving component.
$T_{DISCHARGE}$	Discharge Time	250 (max)	250 (max)	ms	Time to discharge the instantaneous voltage to 500mV on SSRX at the connector. Tested with transmitter with maximum AC coupling capacitance. $T_{DISCHARGE}$ shall be met if SSRX is AC coupled.

Note
1. Impedance is only specified for ΔV>0. ΔV<0 is not specified and could be as low at 0Ω.
2. Steady-state is defined as no change voltage on Tx or Rx nodes and zero current flow through the AC cap.